TESTIMONY OF JIM GERINGER

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WYOMING GOVERNOR (1995-2003)

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SUBMITTED ON APRIL 27, 2006, TO THE
U.S. SENATE COMMITTEE ON COMMERCE, SCIENCE & TRANSPORTATION,
SUBCOMMITTEE ON DISASTER PREVENTION & PREDICTION

THE HONORABLE JIM DEMINT, CHAIR

Chairman DeMint, Ranking Member Nelson, members of the Committee, special guests, ladies and gentlemen. My name is Jim Geringer. I am the Director of Policy and Public Sector Strategy for Environmental Systems Research Institute (ESRI), the industry leader for geospatial information systems. I served as Governor of Wyoming from 1995 to 2003. I am also a representative of the Alliance for Earth Observations, a nonprofit initiative to unite the private sector in the mission to promote the understanding and use of Earth observations for societal and economic benefit. My testimony today will be from my perspective of each of these roles.

Of all the commodities sought in our marketplaces today, none will have higher priority in the future than the universal commodity—water. Not oil or gold or pork bellies, but water. Your hearing today is about water, or more specifically the absence or shortage thereof.

SITUATION

Natural disasters, both locally and globally, are increasing while the overall level of financial assistance available for emergency response in the world has been shrinking since 1992[1] according to a recent statement by the Inter-American Development Bank and a separate story last week by the *Financial Times*. Tsunamis, earthquakes, floods, fires, hurricanes, volcanoes, landslides and drought are in the news with regularity. The U.S. is expected to lead the effort to predict, respond and recover. We face infinite demands with finite resources.

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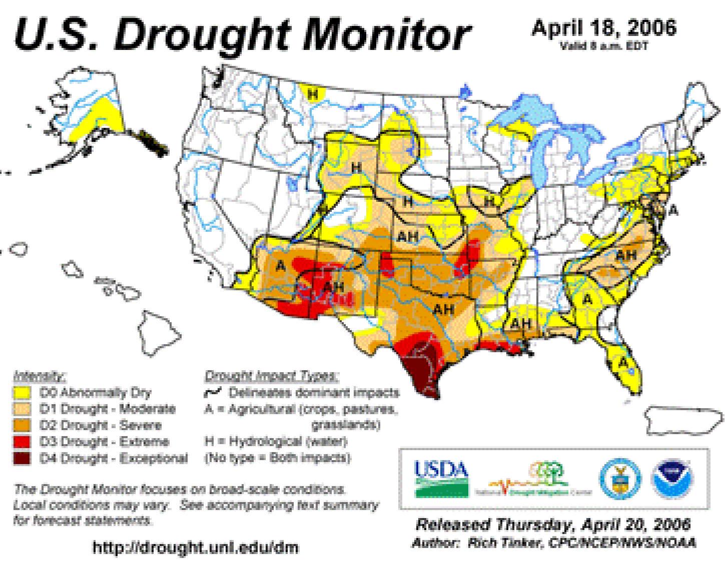
[1] Inter-American Development Bank, March 2006.
http://www.iadb.org/SDS/ENV/site_2493_e.htm

Much is expected of any elected or appointed official. Lives and livelihoods depend upon effectively dealing with disaster. The best way for any of us to deal with disaster is to prevent it altogether. The irony is that prevention does not attract attention and many times does not attract funding. As Governor, if I had called a press conference to announce the prevention of a disaster, I would not have drawn much of a crowd. But I'd better be prepared to react well in response and recovery if one were to happen or else face harsh criticism. In the case of weather-related natural disasters, prevention may not be within our power. That doesn't mean we stoically accept what comes along if more can be done for prediction if not prevention of drought.

Drought is different from other natural hazards or disasters. Drought is slow to develop, a silent, creeping phenomenon evolving over a period of months and sometimes lasting for years. Much of the Midwest and East Coast suffer from water shortages today, as well as Texas, Oklahoma, Louisiana, South Carolina, and Alaska. Parts of the American West are in their eighth consecutive year of a prolonged drought.



Impacts are complex, affecting agriculture, energy production, transportation, tourism, recreation, forests, municipal water supplies, environment, wildlife, and human health. Drought is estimated to result in average annual losses to all sectors of the economy of between $6-8 billion.[2] First responders to a disaster deserve our full support. In the case of drought, the first responders are those who are affected by the drought.

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[2] *Economic Impacts of Drought and the Benefits of NOAA's Drought Forecasting Services,* NOAA Magazine, September 17, 2002. Website: http://www.noaa.gov/magazine/stories/mag51.htm.

PROBLEM

The problem is two-fold. First, our federal policy and programs foster dependency rather than enabling risk management. Second, our Earth observation systems, including for drought, are neither efficient nor integrated.

On the first matter—federal disaster relief programs for nearly every type of natural disaster are not well coordinated. They target funding for reaction rather than at planning, prevention, prediction and mitigation. The unintended consequence is that we are more vulnerable to future damage and cost because we mask the impact of the loss. For example, when a natural phenomenon such as drought occurs on a widespread basis, a disaster is declared and funds are made available to mitigate or eliminate the losses. Government's focus is on aid to victims. We have created a culture of expectation that government will always be there with money.

We need to break the cycle of expectation of reconstruction after destruction. If we don't, we will be faced ever increasing federal assistance. We must shift the focus to planning and prediction, even if prevention is not an option.

Secondly, detection, monitoring, and analysis today are a fragmented patchwork of custom applications, not networked or integrated. We cannot justify duplication of sensors, data acquisition or information infrastructure. We do not have a fully integrated system of systems for observing the Earth and process the data collected.

We are not doing enough as a nation to assure that proper data is on hand to deal with a disaster on the scale of Hurricane Katrina. When a severe weather event occurs, it very quickly evolves into a disaster response event, an energy event, a transportation event, or a public health event. The event is rarely is just about weather, just as drought isn't just about agriculture. We as a nation do not have an integrated base of reference data and application solutions to effectively and promptly respond. If we look at it that way—that we as a nation do not have the tools to respond to drought and other natural hazards—we can also say, American economic competitiveness is at risk.

We must realize that any solution we develop to respond to drought and develop integrated information and tools will impact our country far beyond our original intent. Whether you are a state water manager, a conservationist, or a manufacturer, you need accurate and timely data and information to manage risk. And, that information provides great advantage to us as a nation. As Warren Isom, Senior Vice President of Willis Re Inc., and Board Member of the Weather Risk Management Association said recently, "The weather risk market—in fact the risk-management business in general—has a profoundly strong interest in serious, systematic attempts to improve, expand and intensify the capture of data relating to our planet."

Greater self-reliance through risk management will generate savings from federal assistance programs allowing the redirection of funds rather than necessitating new taxes.

SOLUTION: TECHNOLOGY

On June 21, 2004, the Western Governors unanimously adopted a report entitled, *Creating a Drought Early Warning System for the 21st Century: The National Integrated Drought Information System*. I've included a copy in *Appendix A* of my written testimony. I strongly support the creation of NIDIS. The strongest case for NIDIS is to enable risk management by individuals, businesses and governments—shift from reaction and response to prediction and mitigation. With better sensors, data, applications, tools and ever improving technology we can reward risk management over resignation to the elements.

Enhancing our ability to detect, monitor and respond will enable municipalities to adopt water policies that minimize or eliminate water shortages, farmers to plant alternative crops, ranchers to locate alternatives for grazing, river barges to anticipate low flows in navigable waterways, and health agencies to control disease.

We should develop a culture among agencies and levels of government to share data, applications and predictions, then serve the results to the public so that we individually and collectively are more self-reliant and less vulnerable.

The next drought or the next disaster can occur anywhere in the U.S. Strong, cooperative relationships among agencies are essential to a comprehensive integrated system. A description of applications and data approaches describing how agencies worked together in the response to Hurricane Katrina is included as *Appendix B, GIS FOR THE NATION.*.

This isn't just about the United States. Weather is local in effect but global in generation. We should cooperate with other countries to set up a Global Earth Observation System of Systems (GEOSS), and with each other to implement the U.S. component of the multinational system, the U.S. Integrated Earth Observation System (IEOS). These systems will leverage our investments, programs and data, allowing us to analyze, model, plan and act in advance to minimize weather disasters, including drought.

In today's global economy, innovation is the key to competitiveness. My main message to you today is: The United States must stay at the forefront of Earth observation and geospatial technologies to better forecast and mitigate natural disasters and thereby lead the competition.

As U.S. Commerce Secretary Carlos M. Gutierrez remarked at the Earth Observation Summit III on February 16, 2005, in Brussels, Belgium:

> "I don't think I am overstating it when I say that I believe this integrated observing system will be one of those rare technologies that will fundamentally change the way we live, the way we make policy decisions, and the way we manage scarce and precious resources."

POLICY

General Earth observation policies should be set by the Congress and implemented cooperatively through the President's Cabinet. The proposed legislation would set the NIDIS up under the National Oceanic and Atmospheric Administration (NOAA). While I applaud the heroic support and effort of the NOAA Administrator, VADM Lautenbacher, and his team, I submit that NIDIS—because of its significant social and economic impact—should be part of an overall IEOS/GEOSS Program Office directly under the Secretary of Commerce.

MOVING FORWARD

NIDIS, IEOS, and GEOSS are as much about service as they are technology. The service these integrated information systems promise to provide is the mitigation of the effects of natural disasters through better risk management. The United States must continue to maintain a robust observing capability through satellites, aircraft, unmanned aerial vehicles, buoys, and river and stream gauges. Equally important, we must also continue to support the important acquisition and transformation of data, using geospatial technologies, into useful information for decision makers.

More than 60 countries support GEOSS. And, here in the United States, the private sector—industry, academia, and non-governmental organizations—through the Alliance for Earth Observations is working in close partnership with the government to take a proactive role in moving the IEOS/GEOSS concept forward. One of the most challenging aspects is designing the architecture of these systems. I am pleased to submit with my testimony a copy of the final workshop report, *Earth Observation System Architecture: Enabling an Entrepreneurial Environmen*t. Sixty-five representatives of some of the nation's most innovative businesses and academic institutions contributed their knowledge and experience to help guide U.S. IEOS/GEOSS architecture development. A copy of the report is included in *Attachment C*.

Moving forward to respond to drought requires a technology solution including sensors and applications. NIDIS, IEOS, and GEOSS provide such a solution not only for U.S. response to drought, but also to various natural disasters, and build our technological capabilities and competitiveness as a nation. We must retain leadership in this critical area.

I urge the Senate to move forward with legislation to establish NIDIS, and begin development of the U.S. IEOS as a contribution to GEOSS. It will be of great benefit to our nation, its citizens, and countries worldwide.

APPENDIX A

Creating a Drought Early Warning System for the 21st Century: The National Integrated Drought Information System

http://www.westgov.org/wga/publicat/nidis.pdf

APPENDIX B

GIS For the Nation

The NIDIS can be the beginning step in developing a comprehensive national data set that allows us to plan, prepare and reduce risk, and then to be more effective if and when a natural disaster occurs. The initial response to Katrina consumed at least four weeks while folks feverishly scrambled to assemble enough basic information to know how to manage response and recovery. At no time was there a single emergency response center for the overall operation.

The good news is the United States Geological Survey (USGS), the National Geospatial-Intelligence Agency (NGA), and the United States Department of Homeland Security (DHS) with the assistance of hundreds of state, local[governments?] and private people[citizens?] implemented a Geographic Information Systems database for areas affected by hurricanes Rita and Katrina. Such a database must be deployed when a major disaster is imminent in order to leverage critical but disparate datasets.

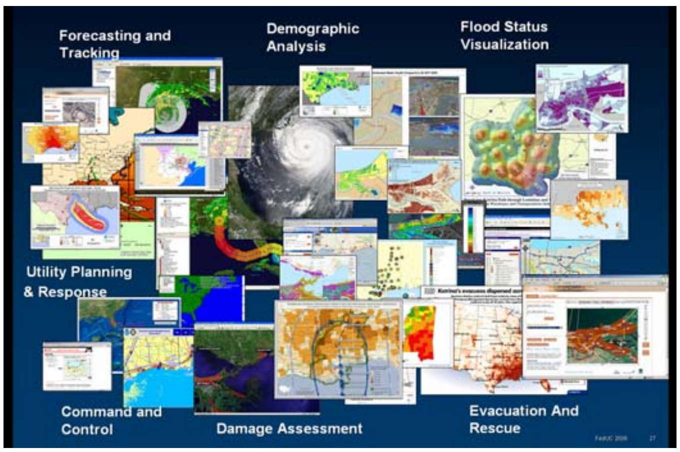
Their aim was to meet the immediate hurricane response needs, to provide a resource for long-term recovery and reconstruction efforts, and to assist in preparedness for future hurricane seasons. Their effort became known as "GIS for the Gulf," which includes the states of Alabama, Louisiana, Mississippi, and Texas. They worked to connect many different GIS systems and datasets into a greater whole. These organizations began to share, import, integrate, and synchronize information needed by the Emergency Operations Centers. The result was a comprehensive database based on a standardized, multi-scale data model, providing a consistent view of data across jurisdictional boundaries. Unfortunately, many of the most important integrated datasets were not assembled or available for use until four weeks after Katrina made landfall. They should have been there before.

This system should be extended to the rest of the United States as "GIS for the Nation." It has the potential to save lives and property during future events, by saving time, resources, and manpower, provided that the infrastructure and data systems are in place and accessible to those who need it prior to, during, and after an event. The concept applies directly to drought assessment and response through NIDIS, allowing better risk assessment for agriculture, economic development, health, homeland security, public safety, and transportation, and allowing government units to better prepare for and mitigate the effects of drought.

GIS for the Nation would integrate essential data and imagery related to emergency operations, structures/critical infrastructure, government units, utilities, addresses, transportation, cadastral, hydrography, environmental, land use/land cover, base-map, elevation, and geodetic control. Data providers should include local, county, state, and federal agencies who currently have such information at their disposal, but do not have the infrastructure in place to leverage it for prediction, prevention and mitigation.

The database would consist of roughly 60 data layers, including detailed parcel information and aerial imagery, combined with a suite of applications that allows data to be viewed, analyzed, and manipulated as a decision support system.

Pre-event preparedness, particularly a fully integrated, deployable GIS infrastructure, is the most effective and valuable action that can and should be taken. It would improve many different emergency response capabilities and processes for future events. It would also provide enormous value for long-term recovery.



This isn't just about federal agencies. Local organizations and private industry generate and own much of the essential data and capability. An integrated information system must coordinate with statewide GIS leaders to ensure that partnerships and data sharing agreements are in place. The time to develop collaborative relationships is not during an emergency, but well before.

GIS for the Nation would facilitate the exchange of data and knowledge prior to an event, including information regarding what data exists, where it is located, who owns it, how accessible it is, and what specific security levels are needed. Much of the base-map (framework) data has already been collected and made available through the *National Map* and through the National Integrated Land System (NILS) developed by the Bureau of Land Management (BLM). NILS represents the essential framework but does not include all of the 60 data layers that are needed.

APPENDIX C

Earth Observation System Architecture: Enabling an Entrepreneurial Environment

October 27-28, 2005
Washington, D.C.

<u>Workshop Final Report</u>

Prepared for
U.S. Group on Earth Observations
Washington, DC

by
The Institute for Global Environmental Strategies
Arlington, VA
Reference: NOAA Contract DG133E05CN1098

January 12, 2006

Earth Observation System Architecture: Enabling an Entrepreneurial Environment

Workshop Final Report

I. Introduction

As part of an effort to acquire input on current planning for the U.S. Integrated Earth Observation System (IEOS) architecture, the U.S. Group on Earth Observations (USGEO) sponsored a workshop on Oct. 27-28, 2005, in Washington, D.C. The workshop, titled "Earth Observation System Architecture: Enabling an Entrepreneurial Environment," included 65 participants representing the following companies, organizations and agencies:

The Aerospace Corporation
Applied Science Associates, Inc.
Atmospheric & Environmental Research, Inc.
Blueprint Technologies, Inc.
The Boeing Company
Calit2, UCSD
CIESIN, Columbia University
Computer Sciences Corporation
Earth 911
Emergency Information Systems
ESRI
E Team, Federal Market and National Capital Region
Foundation for Earth Science
Geophysical Development Corporation
Global Science & Technology, Inc.
Group on Earth Observations
Harris Corporation
I.M. Systems Group, Inc.
Innovative Emergency Management, Inc.
Institute for Global Environmental Strategies
Itri Corporation
Lockheed Martin
MDA Federal, Inc.
Microsoft MapPoint
NASA
NatureServe
Northrop Grumman
Open Geospatial Consortium, Inc.
RAINS
Raytheon
Science Applications International Corp.
University of Maryland
U.S. Department of Commerce/NOAA
U.S. Environmental Protection Agency
U.S. Geological Survey
W.T. Chen & Company
White House Office of Science and

A copy of the workshop agenda is included in *Appendix A*. The results of this effort are detailed on the following pages.

II. Overview of IEOS and GEOSS Planning

To establish a framework for the workshop deliberations, presentations on current U.S. and international Earth-observation planning efforts were provided to the participants. Since the first Earth Observation Summit was held on July 31, 2003, much work has been done to identify how to move forward with the U.S. Integrated Earth Observation System (IEOS) and the multinational counterpart, the Global Earth Observation System of Systems (GEOSS). Chapter 5 of the *GEOSS 10-year Implementation Plan Reference Document* provides a solid foundation for developing a viable architecture for a system such as GEOSS. An outline of the chapter is provided in Figure 1.

5. Architecture of a System of Systems
  5.1 Functional Components
  5.2 Observations
    5.2.1 Convergence of Observations
    5.2.2 Observation Continuity
    5.2.3 Data Sampling
  5.3 Data Processing
    5.3.1 Common Products
    5.3.2 Modeling and Data Assimilation
    5.3.3 Data and Product Quality
  5.4 Data Transfer and Dissemination
  5.5 Interoperability Arrangements
  5.6 Collaboration Mechanisms
  5.7 Initially Identified GEOSS Systems
  5.8 Targets to Enable the Architecture for GEOSS

Figure 1: Outline of Chapter 5

Although many key aspects of architecture development are addressed in this chapter, the level of detail is not sufficient (nor was it intended to be) to provide specific guidance for the development of new GEOSS assets or the evolution of existing assets into a system-of-systems paradigm. Clearly, additional direction is required. This need for further guidance is made even more apparent when one realizes that existing assets, namely

- Observation Systems (weather satellites, river gauges, ocean buoys, etc.);
- Data Processing and Analysis Systems;
- Archive, Stewardship and Discovery Systems; and
- Exploitation and Decision Support Systems

are numerous, geographically dispersed, and evolving on their own time scales. In addition, new GEOSS assets are currently in various stages of development (and some, like NPOESS or GOES-R, will be significant contributors to the GEOSS enterprise). Thus, the sooner that we can provide additional, specific guidance to assist in the evolution and/or development of these assets, the higher probability that they will be able to interoperate effectively within the GEOSS context.

This situation raises an interesting dilemma. What is the best strategy to advance GEOSS architecture to the next level, facilitating interoperability without being overly prescriptive and without inhibiting creativity and innovation in element design, implementation and/or evolution? One possible methodology relies on the development of reference architectures for subsets or threads of what are referred to in this report as GEOSS value streams.

III. GEOSS Value Streams

It is possible to break down the high-level GEOSS architecture (Figure 2) into a set of related and complementary "value streams" (Figure 3) that act as blueprints for extracting value from Earth observations.

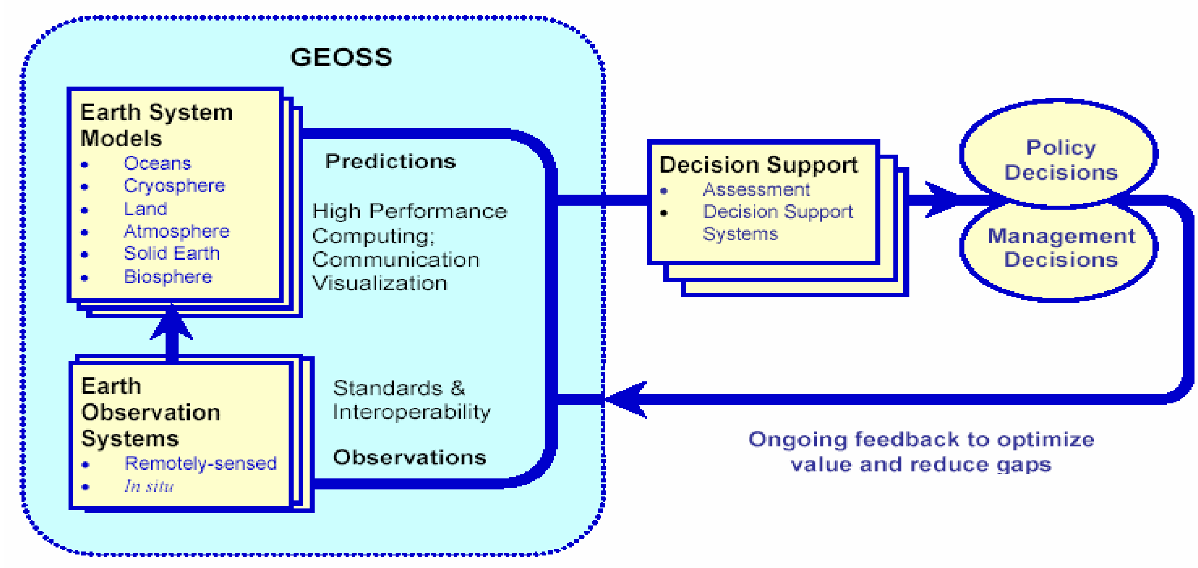
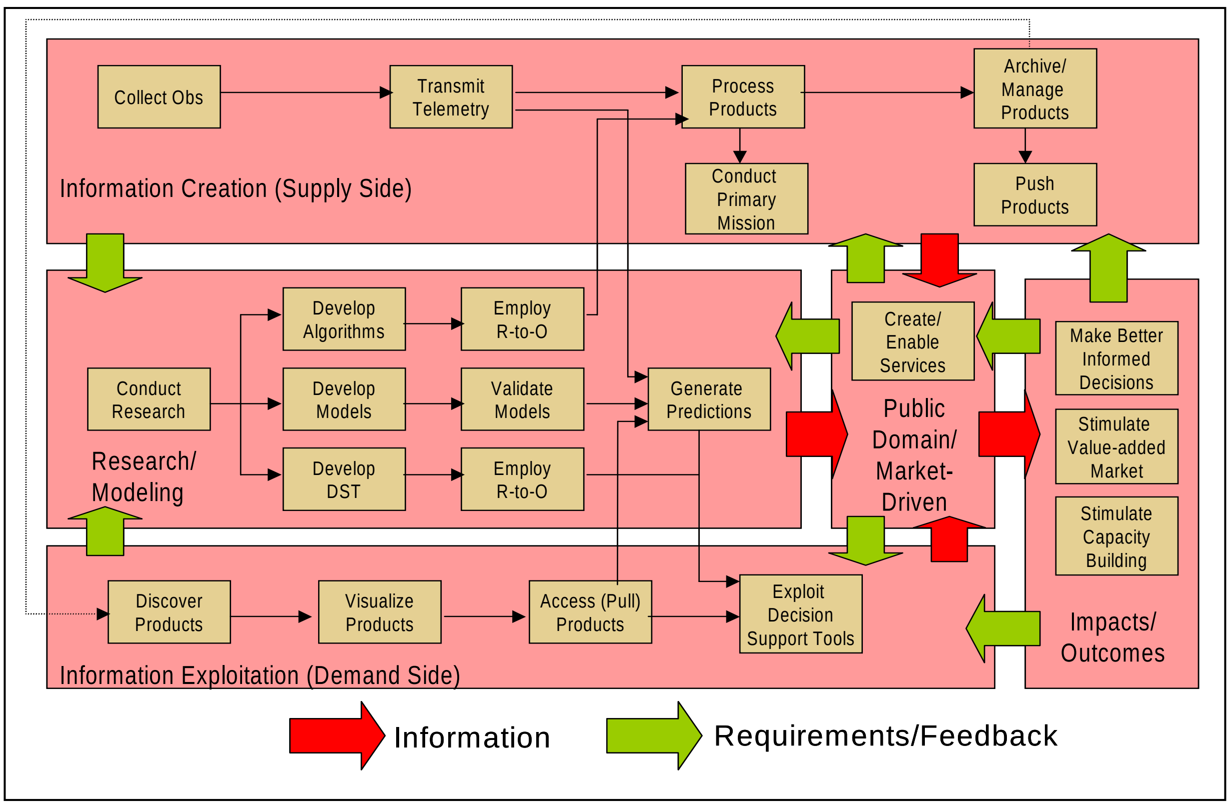


Figure 2: GEOSS Architecture



Appropriate feedback loops within the architecture and value streams ensure that end-user requirements filter throughout the entire enterprise. The depiction of the GEOSS value streams is an evolving concept. It becomes more detailed as more and more stakeholders review and react to it. Nonetheless, in its current form it provides a reasonable starting point for a more detailed analysis of proposed GEOSS architecture methodology.

The value streams are described in greater detail in Table 1 below.

Table 1 GEOSS Value Streams

Value Stream	**Description**
Information Creation	This value stream begins with the collection of environmental observations. Typically, these observations are collected with a primary objective or mission in mind. For example, atmospheric temperature soundings derived from NOAA polar-orbiting satellites are collected mainly to support the forecast efforts of the National Weather Service. These observations can be transformed into products that can be archived and managed. In some cases, products are pushed to certain users. The key for GEOSS is to provide the interoperability constructs so that data collected for a primary mission can be exploited effectively for a variety of applications, some of which may not have even been thought of yet.
Information Exploitation	This value stream begins with the discovery of information, products and services that are maintained at some location. Visualization or browsing may be required to assist in the discovery process. The asset is then obtained (pulled) via network, mail or some other method of access. Exploitation using decision support tools may require integration with predictions derived from model output. This value stream is usually asynchronous with respect to the first one.
Research/ Modeling	This value stream includes the basic research that is needed to develop algorithms that are used to generate environmental data products, models that produce environmental predictions, and decision support tools (DSTs) that enable informed actions on key societal issues.
Service Creation (Public Domain/ Market Driven)	This value stream is a placeholder of sorts that represents the instantiation of a service-oriented architecture for GEOSS. The promise of GEOSS lies in the ability to discover, tailor, and orchestrate particular services to support a variety of end-user applications. It is likely that some of the services created will be geared toward supporting the public good. These services will likely be in the public domain; they may be available for use by anyone who can take advantage of them. In other cases, services will arise due to market-driven demand. These services may exist within a commercial domain only.
Impacts/ Outcomes	This value stream illustrates the fundamental impact and outcome goals of GEOSS: • To provide the ability to exploit environmental observations in the decision-making process for issues of key societal importance; • To enable the creation of a secondary, value-added market for environment-related products and services; • To support capacity building in the developing world.

IV. Pattern-Based Reference Architecture

"Reference architecture" refers to a process that takes a portion or thread of a particular value stream and characterizes it along three dimensions:

- **Structure**: Who/what are the entities/players and what are the key internal/external interfaces?
- **Behaviors**: What processes are exposed at the interfaces?
- **Global Rules:** What are the standards, constraints, enablers and issues that impact the structure and behaviors?

The characterization of a value stream thread along these three dimensions addresses the *what* and *who* of the thread, but not on the *how* and *why*. It can help ensure that a particular instantiation of a process or thread has the required entities and interfaces, and exposes the desired behaviors at the interfaces, but it in no way limits creativity or innovation in design or implementation. In addition, some processes or threads are very common and can be found in many of the assets that are intended to become part of GEOSS (data discovery or product visualization, for example).

This is where the concept of "pattern-based" comes in. If a reference architecture developed for a specific part of the GEOSS value stream is designed around a base pattern, is well documented, and is easily accessible, then it can be reused and tailored to meet specific end-user requirements. The more pattern-based reference architectures that are developed and vetted through community-wide use, the greater the probability that they will reduce overall risk in terms of schedule, cost and performance, and reduce life-cycle cost across the enterprise.

This is particularly important in light of the fact that:

- GEOSS is comprised of a collection of assets that will evolve or be created over time, on their own time scales.
- These assets become part of GEOSS when they expose products or services that are consistent with GEOSS interoperability constructs.
- Pattern-based reference architectures would provide a blueprint for asset development/evolution and enhance the probability that they would be compatible with such constructs.

V. Architecture Workshop Overview

Sixty-five participants attended the USGEO-sponsored workshop, which was designed to take the discussion of GEOSS architecture to the next level.   The Institute for Global Environmental Strategies organized the workshop with significant contribution by members of the Alliance for Earth Observations—a partnership of industry, academic, and non-governmental organizations dedicated to promoting the use of Earth observations for social and economic benefit.

The specific objectives of the workshop were to:

- Provide the private sector an opportunity to review the high-level architectural framework for both GEOSS and IEOS.
- Introduce the concept of pattern-based reference architecture and apply the approach to some specific threads of the GEOSS value stream. The goal here was not to generate reference architecture per se, but rather to see if the proposed methodology could generate enough traction among the diverse group of GEOSS stakeholders in attendance to demonstrate the viability and feasibility of the approach.

Most of those invited were primarily members of the private sector, although the U.S. government, the academic community and nongovernment organizations were also represented. If the methodology proved to be viable, then other stakeholders would have to be entrained into the process in some logical and efficient way.

Four threads of the GEOSS value stream were chosen as foci for the workshop. These threads were not randomly selected; they represented four areas where significant opportunity for progress existed:

- **Spatially Enabled Search Portals** (an attempt to engage key private sector players, such as Microsoft and Google, that are moving aggressively in this area);
- **Georeferenced Emergency Alerting** (a timely application that provides a chance to exercise the GEOSS value stream, end to end);
- **Modeling and Data Assimilation** (a key element of the GEOSS value steam that heretofore has been largely an academic exercise);
- **Service Interface for Decision Support Tools** (a key component as far as implementing an outcome-based, service-oriented architecture approach).

For each focus area, the workshop convened both an expert panel and a working group:

- The purpose of the **expert panels** was to bring together experts from within the focus area and allow them to comment on the current state of the practice. Panel members were also encouraged to highlight issues of concern and identify constraints and enablers. Each panel was an attempt to gather useful background information for participants prior to breaking out into working groups.

- **Working groups** were tasked to begin developing some reference architecture artifacts (diagrams, charts and lists) for their particular focus area:

    - **Structure:** Value Stream Diagrams; Input-Process-Output (IPO) Charts for each step in the value stream; Domain Collaboration Diagrams
    - **Behaviors:** List of use cases; creation of key use cases
    - **Global Rules:** Prioritized lists of relevant standards, issues, enablers and constraints

The artifacts generated by each working group are provided in *Appendix B.*

VI. Key Findings

The key findings of the workshop are summarized below:

1. The private sector had the opportunity to review the high-level architectural approach for both IEOS and GEOSS. Participants agreed that **the initial direction is basically comprehensive, logical and pragmatic.**

2. Given the realities of GEOSS/IEOS, namely that

    a. Many assets are yet to be developed or will evolve along their own time scales; and that
    b. These assets span many dimensions (discipline, geopolitical, functional);

    participants found that the **pattern-based reference architecture paradigm provides a logical and powerful way forward** for GEOSS/IEOS design and implementation (Figure 4).

3. The **private sector has much to offer in this area** in terms of experience, tools, methodologies and best practices.

4. The **private sector is willing to step up and lead** this activity, but **it will not succeed unless there is ongoing active collaboration between all stakeholders.**

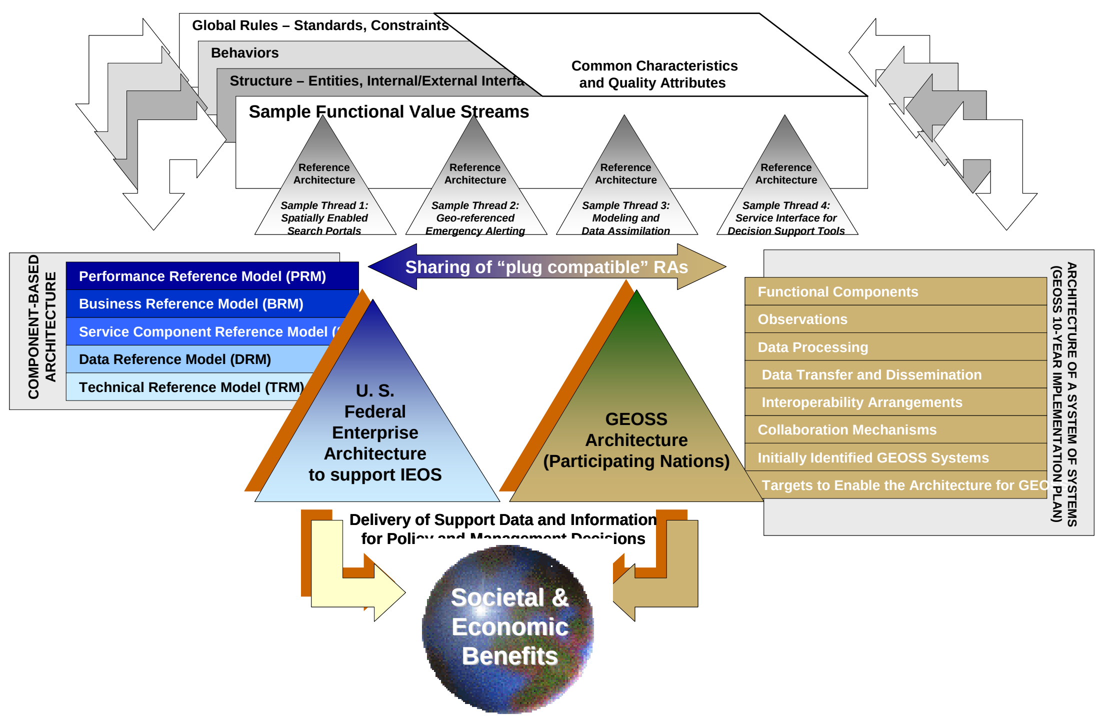


Figure 4: Benefits of Pattern-Based Reference Architecture

Based on these key findings, the workshop participants offer the following recommendations:

- The USGEO should review the results of the workshop and consider endorsing the pattern-based reference architecture methodology as one way forward to taking the GEOSS architecture discussion to the next level.

- The broader the stakeholder base that buys into the methodology, the more likely that patterns will be defined, registered and reused. The USGEO should engage other stakeholders (including their counterparts in Europe and the Asia/Pacific region) into this discussion.

- GEOSS assets already exist. If we hope to influence their evolution, it is essential that we provide substantive guidance sooner rather than later. We probably cannot wait until "we get it 100% right." It is probably better to get some reference architectures for key threads of the GEOSS value stream into the hands of those who can make use of them and, subsequently, provide insights and lessons learned. Reference architectures are dynamic entities that will improve with time.

- The scenario described above points to the need for some sort of repository for reference architectures, and for some minimal set of procedures that can be used to govern the review/adjudication process.

- The scenario also suggests that everyone needs to appreciate that there is no single "right answer." Several reference architectures may exist for a given process, each compliant in its own right but emphasizing some unique aspect of the value stream. Diversity is fine as long as it is interoperable.